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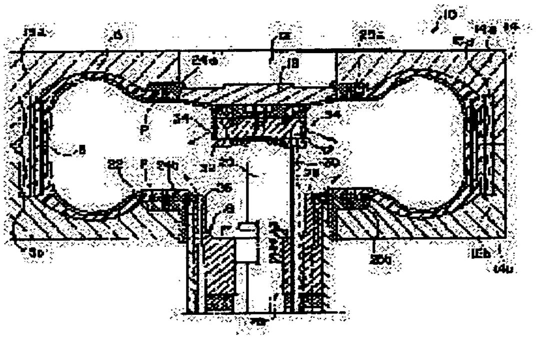
(54) TIRE VULCANIZING METHOD AND APPARATUS

(57)Abstract:
PURPOSE: To properly and sufficiently heat the whole of a green tire within a shorter time.
CONSTITUTION: The bead rings 24a, 24b holding the bead part of a green tire are externally fitted to upper and lower clamps 16, 18 and cylindrical coils 25a, 25b are embedded therein. Further, cylindrical coils 15a, 15b are embedded in upper and lower molds 14a, 14b so as to surround the part corresponding to the tread part of the green tire. An AC power supply is connected to the respective coils 15a, 15b, 25a, 25b through a current value control unit and, at the time of vulcanization, the magnetic fields due to the coils 15a, 15b, 25a, 25b are generated in the bead P and belt layer B of the green tire.



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[Title of the Invention] TIRE VULCANIZATION METHOD AND APPARATUS THEREOF

[Abstract]

[Object] To sufficiently heat the whole green tire without any excess or deficiency in a shorter period of time.

[Constitution] Bead rings 24a, 24b for holding bead portions of a green tire G are externally fitted to an upper side clamp 16 and a lower side clamp 18 and cylindrical coils 25a, 25b are respectively buried inside the clamps. Inside an upper die 14a and a lower die 14b, cylindrical coils 15a, 15b are buried so as to surround a part corresponding to a tread portion of the green tire G. These coils 15a, 15b, 25a, 25b are respectively connected to an AC power source through an electric current value adjusting device or the like and upon the vulcanization, magnetic fields due to the respective coils 15a, 15b, 25a, 25b are generated in parts of beads P and a belt layer B of the green tire G.

[Scope of Patent Claims]

[Claim 1] A tire vulcanization method for vulcanization molding a green tire having beads and a belt layer made of conductive materials by means of a die, characterized in that upon vulcanization molding of the green tire, by generating magnetic fields in parts of the beads and the belt layer, an eddy current generated by electromagnetic induction is induced in said beads and said belt layer and by heat generation of the beads and the belt layer caused by the generation of the eddy current, the green tire is heated from the inside.

[Claim 2] A tire vulcanization apparatus for vulcanization molding a green tire having beads and a belt layer made of conductive materials by means of a die, characterized in that coils for generating magnetic fields in parts of beads and a belt layer of said green tire are provided in said die and the coils are connected to an AC power source.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to a tire vulcanization method for vulcanization molding a green tire having beads and a belt layer made of conductive materials by means of a die and an apparatus thereof.

[0002]

[Conventional Art] Conventionally, as a method for vulcanization molding a green tire, while the green tire is expanded and deformed into a toroidal shape by a die, it is heated from the inner periphery side and the outer periphery side of the tire in order for vulcanization molding.

[0003] An apparatus for vulcanization molding a green tire generally comprises a central mechanism for attaching the green tire and a die provided in the outer periphery of the central mechanism for molding the green tire into a predetermined shape. The central mechanism is provided with a bladder for expanding the green tire into a toroidal shape. Upon the vulcanization molding, after attaching the green tire to the central mechanism, by supplying a vulcanization medium of high temperature and high pressure into the bladder, the bladder and the green tire are integrally expanded and deformed into a toroidal shape, and at a predetermined timing, the green tire is sandwiched by the die, thereby the green tire is molded into a predetermined shape. At this time, since the die is heated to a predetermined temperature, the green tire is uniformly heated from the outer periphery side by the die and from the inner periphery side by the heat medium through the bladder.

[0004]

[Problems to be Solved by the Invention] A tire is constituted such that thickness of the tire is relatively large in a tread portion and bead portions and relatively small in a sidewall portion and the like.

[0005] However in the vulcanization apparatus, since the green tire is uniformly heated from the inner periphery side and the outer periphery side, the tread portion and the bead portions whose thickness is large are not easily heated in comparison to the sidewall portion and the like, and consequently tend to remain in an unvulcanized state. Therefore, in reality, the vulcanization is performed such that time for completely heating the tread portion and the bead portions is vulcanization time of the green tire.

[0006] However, due to the fact that there is a need for taking a long time for completely heating the tread portion and the bead portion, and the fact that there is a fear that this may lead to an over-vulcanized state in the sidewall portion and the like whose thickness is small, with regard to the vulcanization molding of the green tire, shortening of the vulcanization time by sufficiently heating the tread portion and the bead portions in a shorter period of time is preferable for avoiding the above-mentioned problems and also for improving work efficiency.

[0007] In consideration to such facts, by perceiving that many of beads and belt layers are made of conductive materials in a structure of a tire, the object of the present invention is to provide a tire vulcanization method and an apparatus thereof capable of sufficiently heating the whole tire without any excess or deficiency in a shorter period of time.

[0008]

[Means for Solving the Problems] The invention according to claim 1 is a tire vulcanization method for vulcanization molding a green tire having beads and a belt layer made of conductive materials by means of a die, wherein upon vulcanization molding of the green tire, by generating magnetic fields in parts of the beads and the belt layer, an eddy current generated by electromagnetic induction is induced in the beads and the belt layer and by heat generation of the beads and the belt layer caused by the generation of the eddy current, the green tire is heated from the inside.

[0009] The invention according to claim 2 is a tire vulcanization apparatus for vulcanization molding a green tire having beads and a belt layer made of inductive materials by means of a die, wherein coils for generating magnetic fields in parts of beads and a belt layer of the green tire is provided in the die and the coils are connected to an AC power source.

[0010]

[Operation] According to the invention described in claim 1, upon vulcanization molding of a green tire, followed by generating magnetic fields, an eddy current is generated by electromagnetic induction in beads and a belt layer of the green tire. When the eddy current is generated in the beads and the belt layer, by resistance of conductive materials constituting the beads and the belt layer, Joule heat is generated in the beads and the belt layer and the beads and the belt layer themselves generate heat. Therefore, by the heat generation of the beads and the belt layer, bead portions and a treat portion are heated from inside thereof.

[0011] According to the invention described in claim 2, upon vulcanization molding of a green tire, by receiving a current supply from an AC power source, magnetic fields due to coils are generated in parts of beads and a belt layer of the green tire, thereby an eddy current is generated in the beads and the belt layer. By the eddy current and resistance of conductive materials constituting the beads and the belt layer, Joule heat is generated inside the beads and the belt layer, and the beads and the belt layer are heated from the inside thereof.

[0012]

[Embodiment] A vulcanization apparatus according to the present invention will be described with reference to the drawings.

[0013] As shown in Fig. 1, a vulcanization apparatus 10 comprises a central mechanism 12 for expanding a green tire G formed in a molding process into a toroidal shape, and a molding die 14 for molding the green tire G into a predetermined shape, for example molding tread patterns onto the green tire G expanded into a toroidal shape. It should be noted that the figure shows a state that the green tire G is already deformed into a toroidal shape.

[0014] The central mechanism 12 is provided with a lower side clamp 18 attached on a base (not shown), a rod 20 fitted to the lower side clamp 18 so as to rise and fall relatively to the lower side clamp 18, an upper side clamp 16 installed to an upper end part of the rod 20 and a bladder 22 installed over the respective clamps 16, 18.

[0015] The bladder 22 is made by forming a retractable elastic material into a cylindrical shape. Since a lower end part thereof is installed to the lower side clamp 18 and an upper end part thereof is installed to the upper side clamp 16, thereby the bladder 22 is attached to the central mechanism 12. The bladder 22 and the respective clamps 16, 18 form cylindrical sealed space.

[0016] The lower side clamp 18 is provided with a plurality of supply paths 26 and discharge paths 28 communicated with the sealed space formed by the bladder 22. The supply paths 26 are communicated with a vulcanization medium producing device (not shown). The upper side clamp 16 is provided with a tank 32. A plurality of injection holes 34 communicated with the sealed space are formed on the tank 32 and a communication pipe 30 extending toward the lower side clamp 18 is installed to the tank 32. A lower end part of the communication pipe 30 is fitted to the lower side clamp 18 so as to rise and fall relatively to the lower side clamp 18, and communicated with the vulcanization medium producing device. That is, upon the vulcanization of the green tire G, while a vulcanization medium produced in the vulcanization medium producing device (vulcanized gas with high temperature and high pressure in the embodiment) is supplied into the bladder 22 through the supply paths 26, it is led to the tank 32 by the communication pipe 30 and then supplied into the bladder 22 through the injection holes 34. After completion of the vulcanization, the vulcanization medium is discharged to the outside of the vulcanization apparatus 10 through the discharge paths28.

[0017] Bead rings 24a, 24b being parts for holding bead portions of the green tire G are fitted to the upper side clamp 16 and the lower side clamp 18 from the outside when the green tire G is installed. Inside the bead rings 24a, 24b, cylindrical coils 25a, 25b are respectively buried. The coils 25a, 25b are connected to an AC power source through an electric current value adjusting device or the like respectively. Upon the vulcanization of the green tire G, by receiving a current supply from the AC power source, magnetic fields are generated in the periphery of the bead portions of the green tire G.

[0018] The molding die 14 is arranged in an outer periphery portion of the central mechanism 12 constituted as above. The molding die 14 comprises an upper die 14a and a lower die 14b, and the dies 14a, 14b are moved in the axial direction of the rod 20 (in the vertical direction in Fig. 1) by drive means (not shown) so as to be engaged and disengaged with each other. That is, at the time of installing and removing the green tire G, the upper die 14a is moved upward in the axial direction and the lower die 14b is moved downward in the axial direction. Consequently, the molding die 14 becomes an opened state, while upon the vulcanization of the green tire G, as shown in the figure, the dies are moved and abutted on each other so that the molding die 14 becomes a closed state.

[0019] Inside the upper die 14a and the lower die 14b, the cylindrical coils 15a, 15b are respectively buried so as to surround parts corresponding to the tread portion of the green tire G. The coils 15a, 15b are respectively connected to the AC power source through the electric current value adjusting device or the like as well as the coils 25a, 25b of the central mechanism 12. Upon the vulcanization of the green tire G, by receiving a current supply from the AC power source, magnetic fields are generated in the tread portion of the green tire G.

[0020] For vulcanization molding of the green tire G by the vulcanization apparatus 10 constituted as above, firstly the green tire G produced in the molding process is installed to the central mechanism 12. At this time, the installment of the green tire G to the central mechanism 12 is performed with the molding die 14 being in an opened state. After completion of the installment of the green tire G to the central mechanism 12, the vulcanization medium produced in the vulcanization medium producing device is supplied into the bladder 22 through the supply paths 26 of the lower side clamp 18 and the injection holes 34 of the upper side clamp 16, thereby the bladder 22 is expanded and the green tire G is expanded and deformed into a toroidal shape. After the green tire G is expanded and deformed into a toroidal shape as described above, the molding die 14 is closed at a predetermined timing. At this time, the molding die 14 is heated to a predetermine temperature, thereby the green tire G is uniformly heated from the outer periphery thereof by the molding die 14, and also from the inner periphery thereof by the vulcanization medium through the bladder 22 so as to be molded into a predetermined shape.

[0021] The vulcanization apparatus 10 is extremely suitable for the green tire G whose beads P and belt layer B are formed by conductive materials such as steel. That is, upon the vulcanization molding of the green tire G, when the molding die 14 is closed as above, a current supply to the coils 25a, 25b of the bead rings 24a, 24b and the coils 15a, 15b of the dies 14a, 14b is started, thereby in the green tire G being vulcanized, magnetic fields are generated in parts of the beads P and the belt layer B due to the coils 15a, 15b, 25a, 25b as shown in Fig. 2. Upon the generation of magnetic fields as above, since the beads P and the belt layer B are formed by conductive materials, an eddy current is generated inside. By the eddy current and resistance of conductive materials, Joule heat is generated inside the beads P and the belt layer B, thereby the beads P and the belt layer B themselves are heated. That is, the green tire G is constituted such that the bead portions and the tread portion having relatively large thickness and taking substantial time for heating are heated from the inside thereof, thereby these parts are heated in a short period of time.

[0022] Consequently, in the green tire G whose beads P and belt layer B are formed by conductive materials such as steel, as described above, the vulcanization molding is performed by a heating effect from the inner periphery side of the tire by the vulcanization medium and a heating effect from the outer periphery side of the tire by the molding die 14 as well as a heating effect from the inside of the tire by the heat generation of the beads P and the belt layer B. Thereby, it is possible to shorten the vulcanization time of the bead portions and the tread portion and as a result, it is possible to shorten the vulcanization time of the green tire G.

[0023] When the vulcanization time of the green tire G is shortened as above, it is possible to effectively avoid the conventional problem of occurrence of over-vulcanization in parts having relatively small thickness such as a sidewall portion and it is also possible to improve efficiency in producing the tire by shortened vulcanization time.

[0024] The above embodiment is an embodiment of the vulcanization apparatus according to the present invention, and the constitution thereof can be modified within the range not departed from the gist of the present invention. Therefore, the number of winding of the coils 15a, 15b, 25a, 25b, a supply current value, deposition thereof or the like for generating magnetic fields in parts of the beads P and the belt layer B of the green tire G is suitably set so as to effectively induce a heat generation effect of the beads P and the belt layer B in accordance with a shape of the green tire to be vulcanized or the like, and not limited by the present invention. Of course, in accordance with the constitution of the green tire, coils may be provided corresponding to one of the beads and the belt layer so as to generate heat in the beads P or the belt layer B..

[0025] According to the present invention, it is added that a die means not only the molding die 14 described in the embodiment, but also the bead rings 24a, 24b abutted to the outer periphery of the green tire.

[0026]

[Effect of the Invention] As described above, since the present invention is a tire vulcanization method for vulcanization molding a green tire having beads and a belt layer made of conductive materials by means of a die, in which upon vulcanization molding of the green tire, by generating magnetic fields in parts of the beads and the belt layer, an eddy current generated by electromagnetic induction is induced in the beads and the belt layer and by heat generation of the beads and the belt layer caused by the generation of the eddy current, the green tire is heated from the inside. Therefore, it is possible to sufficiently heat the whole tire without any excess or deficiency in a shorter period of time.

[Brief Description of the Drawings]

[Fig. 1] A sectional view showing a vulcanization state of a vulcanization apparatus according to the present invention;

[Fig. 2] A conceptual view showing a generation state of magnetic fields by the vulcanization apparatus according to the present invention.

[Explanation of the Reference Numerals]

10: Vulcanization apparatus
12: Central mechanism
14: Molding die
14a: Upper die
14b: Lower die
15a, 15b: Coil
16: Upper side clamp
18: Lower side clamp
20: Rod
22: Bladder
24a, 24b: Bead ring
25a, 25b: Coil

G: Green tire
B: Belt layer
P: Bead